CONSTRUCTION SCHEDULING: PREPARATION, LIABILITY AND CLAIMS

Jon M. Wickwire, Esq., Stuart Ockman and Mark J. Groff, Esq.

I. DRAFTING SCHEDULE SPECIFICATIONS

With increasing frequency, construction contracts contain detailed specifications sections that prescribe the form and detail of the project schedule and supporting data, the methods for adjusting and updating the schedule, and the use of the schedule for purposes of contract modifications, time extensions, and analysis of performance delays. These specifications and their interpretation must be carefully considered by contracting parties because they often result in important allocations of risk and responsibility. Although well-drafted scheduling specifications are critical to the ability of the parties to achieve their joint goals of timely and economical construction, in practice, schedule specifications are rarely clear and concise. Experience has shown that it is difficult to establish standard schedule specifications for use by the construction industry today. For example, specifications may range from one paragraph to five to ten pages. The short specifications are dangerous, and the long ones expensive. Generally speaking, however, the more detail included in the specifications, the better chance there is to eliminate misunderstandings.

A. LEGAL ASPECTS OF SCHEDULING SPECIFICATIONS

1. FEASIBILITY OF SPECIFIED SCHEDULE

If the schedule specified for a project does not present a feasible or reasonable plan for the sequence and duration of the work and is not properly updated, it is worthless as a pragmatic tool to execute work in the field. Further, such a schedule is useless as a database by which the parties or finders-of-fact can evaluate the actual performance of the work, the effect of delays on the project, and the responsibility of the parties for such delays. Thus, a scheduling specification should call for a real commitment to the scheduling process and require that a schedule actually be used by the parties rather than requiring simply a software exercise. In a number of cases, courts and boards of contract appeals have refused to accept critical path method (CPM) schedules that were not properly prepared or that were not used to actually schedule the work in the field. *See* Fortec Constructors v. United States, 8 Cl. Ct. 490 (1985); Chaney & James Constr. Co., FAACAP No. 67-18, 66-2 BCA ¶ 6066 (1967).

2. TYPE OF DIAGRAM

Schedule specifications need to detail clearly both the specific type of diagram and the network planning technique desired. Vague language may allow the Contractor the opportunity to use bar charts, rather than CPM network analysis system diagrams, as an appropriate schedule, even though it is intended that a time scale critical path network CPM diagram be used on the project. For example, in *H.I. Homa Co.,* ENGBCA No. PCC-41, 82-1 BCA ¶ 15,651 (1982), the contract contained the following provision: "The schedule shall show the order in which the contractor proposes to carry on the work, the dates on which he will start the several salient features (including procurement of materials, plant and equipment) and the contemplated days for completing same." The specifications further provided that the schedule be of a type and size acceptable to the contracting officer. Under these circumstances, the board of contract appeals determined that a CPM network was not required by the contract since a bar chart would meet the specifications. Because the government had required a CPM schedule, the board determined that the Contractor was entitled to additional compensation.

3. NUMBER OF ACTIVITIES

Most schedule specifications require a network showing a minimum number of activities. Such a requirement is sometimes implemented by limiting the duration of individual activities to no more than a stated number of days. It is very important to have a clear idea of the required level of detail for any network diagram. The appropriate number of activities is largely dependent upon the nature, size, and complexity of the project. If too many activities are required, the resulting diagram may not be an effective management tool for field construction. However, if too few activities are specified, the resulting activities may be so gross as to provide for a diagram that does not properly reflect the intricacies or interdependencies of various activities required to be completed on the project.

4. RESOURCE LOADING

Another extremely important requirement for an Owner to include in a competent scheduling specification is one for resource loading of activities. This requirement is commonsensical when we consider that for us to know whether a purported activity duration has any validity we must know its resource loading. This is because the equation which provides us the activity duration requires the application of the productive resource (e.g. number of personnel, equipment) against the projected productivity of those resources. In other words, Resources/ Productivity = Duration (of defined activity). Stated another way, ten workers with a productivity of two windows per day will accomplish a stated activity of twenty windows in ten days. However, if our ten workers have a productivity rate of four windows per day, the activity will only take five days. Without visibility on the part of the Owner or the Construction Manager as to resource loading for a purported activity duration, the Owner has no yardstick to determine whether the Contractor is including realistic activity durations in the original planned network schedule or in estimates of remaining durations in updates.

5. APPROVAL

Schedule specifications should establish whether formal approval of the schedule is required, as well as the party responsible for making the approval. Thus, the specifications should state whether the Owner or Architect/Engineer or Construction Manager approves the CPM schedule. The specifications also should indicate the duration of the approval cycle and include the appropriate leverage to enforce the approval process. The specifications should also clearly state that the Owner is entitled to electronic versions of all schedules (including updates) submitted by the Contractor and electronic versions of all backup to the submitted schedules.

Owners and/or their Construction Managers will occasionally refrain from approving or acting upon a Contractor's proposed schedule because they fear that their response can later be used by the Contractor as acceptance of the schedule and the Owner's responsibility under the schedule. In many cases, this type of forbearance is unsuccessful. Courts have imposed implied obligations upon Owners with regard to the schedule despite the Owner's silence. In one case, when an Owner even orally disclaimed parts of the schedule but failed to actually reject the Contractor's initial proposed schedule, the Owner was held to be bound to time durations contained in the submitted schedule. Fullerton Constr. Co., ASBCA No. 12275, 69-2 BCA ¶ 7876 (1969). *See also* G. Blindzius Contractors, Inc., ASBCA No. 37707, 90-2 BCA ¶ 22,835 (1990).

When a schedule is approved there is a rebuttable presumption of correctness or reasonableness of the schedule. Santa Fe, Inc., VABCA No. 2168, 87-3 BCA ¶ 20,104 (1987). Because of this rebuttable presumption of the reasonableness of the schedule where an approval is in place, many Owners are afraid of approving any schedule much less an early completion schedule. However, the approval process is the only chance for the Owner to weigh in on overly aggressive or erroneous schedules (with

all float removed, defective logic, unauthorized inclusion of constraints, unrealistically short approval cycles, etc.). Case law holds that even where a schedule has been approved it will be thrown out if it contains unrealistic logic and/or durations. See e.g. *Neal & Co. v. United States*, 36 Fed. Cl. 600 (1996); *Hensel Phelps Construction Co.*, ASBCA No. 49270, 99-2 BCA par 30,531 (1999).

6. CONTROL OF RECORD SCHEDULE

The control of the record schedule in its original form and in the various updates is a matter which cannot be ignored by the Owner or Construction Manager. Approvals of the original network or of stipulated revisions to schedule updates (such as correcting for out of sequence logic or unrealistic durations) will be of little value if the Contractor does not maintain the record schedule as agreed by the parties or as required by contract. Without safeguards in the scheduling specification to assure that all parties are working to and evaluating the project from the same schedule, expensive disputes between the parties are a high probability.

7. UPDATING

Most contracts require updating of the schedule during performance. Issues addressed by the specifications include the use of computers in updating, frequency of schedule updates, and what the updates must reflect about changes, delays, or modifications to the plan for the remainder of construction that may be contrary to the original network diagram. Many schedule specifications require Owner approval prior to incorporating logic changes in schedule updates, usually after a joint updating meeting. Conflicts frequently arise where the specifications fail to establish monthly procedures to ensure that the historical work on the project is properly recorded and that the parties agree on the Contractor's game plan for completing the work.

8. COST LOADING

Some Owners require the schedule diagram of activities to be cost loaded for progress payment purposes. The level of detail required for such cost loading should be specified clearly. Owners often retain discretion to adjust the cost loading in order to make certain that they are not subjected to exaggerated front end loading in the cost loading of the diagrams.

9. SUBCONTRACTOR INVOLVEMENT

Most construction projects today place a great level of risk on the major trade contractors. These business entities frequently have the majority of the risk of labor productivity on the project. In fact, the trade contractors may even be operating under the framework of a total broker general contractor, where the general contractor itself performs no physical work on the project. For this reason, as well as for policy considerations of project teamwork, owners have increasingly been requiring the participation of major trade contractors in the preparation of the original CPM, as well as in the updating process.

10. FLOAT USE AND REPORTING

Schedule specifications should address a number of issues concerning float, which is the amount of time that an activity may be delayed without causing delay to the project finish date. First, the contract should state the desired requirements for reporting float. These provisions may require, for example, periodic reports of total or project float, free float, and activity-specific float. These reports can be a useful management tool. Second, the schedule specifications should address the availability of the use of float to the parties and the project. Without risk-allocating provisions, neither party will be entitled to priority in use of float time. In other words, if float is available along the channel of work involved, either

party (as long as it is acting in good faith) may, without being charged for a delay to the project, delay or extend work activities up to the point that the float is extinguished. *See Weaver-Bailey Contractors, Inc. v. United States,* 19 Ct. Cl. 474 (1990).

11. MAJOR REVISIONS AND TIME EXTENSIONS

Schedule specifications should state whether the CPM or network diagrams are to be totally revised or significantly modified if there are major revisions in the project sequence. The contract should also indicate the party responsible for preparing such major revisions to the network diagram and describe the Owner or Construction Manager's rights to approval of any such major revisions. At a minimum, major changes and schedule impacts should be incorporated into the schedule as promptly as possible so that the CPM network accurately reflects current conditions. Thus, contract drafters should also consider specifying the appropriate time for quantifying delays. For example, should the time-extension calculation for the delay be measured based on (a) a CPM update or diagram current as of the time of the delay, (b) the impact to the original CPM plan, or (c) a "20/20" hindsight look at the project? The reference point for measurement of the impact often will have a major effect on the length of the appropriate time extension. Today, the most widely accepted approach for evaluating delays is on a chronological and cumulative basis, that takes into account the status and critical path(s) of the project at the time of the delay in question.

12. PROHIBITIONS ON SCHEDULE MANIPULATIONS

Use of inexperienced personnel to schedule the work and so-called user friendly software advances that mask the logic and changes to CPM networks have led to serious scheduling abuses. As a result many Owners are including specifications which specifically prohibit improper scheduling manipulations, such as the use of automatic default mechanisms to update actual start and finish dates, incomplete predecessors and negative lag relationships.

B. MAJOR AREAS OF CONFLICT IN SCHEDULE SPECIFICATIONS

1. REASONABLENESS OF THE SCHEDULE

Will the schedule actually be used to run the project, or merely be a software exercise? One of the most serious problems in the construction industry today is the lack of commitment by the parties to the construction process to the actual use of the network schedule to plan and execute the work. In the 1960s and 1970s, on major projects, a number of master schedulers worked with the general contractor project superintendents to develop (1) a plan, and (2) a network diagram reflecting preferential and absolute logic, sequence, and duration. These master schedulers would also frequently meet with the project managers for the major trade contractors as well. The computer work for the CPM was done on mainframes and frequently the original plan and updates were hand-drawn. What was significant in these projects was the commitment of the key participants in the project to developing a meaningful plan for executing the work and then actually executing the work.

However, the advent of the mini- and microcomputer (and attendant software), coupled with the failure of specifications to require participation of the master scheduler in execution of the project schedule, has damaged the construction process. The general contractor (or the at-risk Construction Manager) bidding the project today frequently approaches the cost of preparing the detailed project schedule as an exercise driven not by the benefits of a good plan for performance and network schedule, but rather as another place for cutting the bid to become the low bidder. Thus, if some computer processing concern, which will merely process the paper without any knowledge of construction, gives a price of $20,000 to do computer scheduling for the project, as contrasted with an experienced and talented

master scheduler who quotes $100,000, then the general contractor invariably takes the low price. The effect of this trend from the 1960s to the present has been to move almost all experienced master schedulers into the role of claims consultants, rather than positive participants in the development of a good plan and network at the inception of a project. The claims arena was the only marketplace prepared to pay reasonable compensation for the skills of the master scheduler.

As a result of these developments, the master scheduler who could deal with tough construction superintendents as a positive force was lost as a resource to planning and execution of the project. A frequent alternative source today for the construction schedule is a computer service or a junior project engineer. The ill-equipped computer service frequently prepares the network with the assistance of the junior project engineer, or the junior engineer does it herself. As a result, preparation of the plan and schedule frequently lacks real participation or commitment by the executors of the project. The remedy in this area is for the owner to reestablish its willingness to require and pay for a real commitment to the scheduling process—not just a paper exercise that lays the groundwork for later claims disputes.

2. APPROVAL/NONAPPROVAL ISSUE

A question frequently asked by owners is whether they should approve the contractor's schedules. The fear is that somehow the owner will warrant the schedule by its approval. Experience makes it clear, however, that this is an unwise course. The problem is that failure to approve the schedule deprives the owner of the ability to reject unreasonable plans for performance, opens the owner up to potential claims for early completion (which may be based upon defective or unrealistic logic), and denies the parties a baseline from which to evaluate delays. If neither party is operating from an approved baseline schedule, then how will the owner or the contractor have any idea how to evaluate time extensions? In short, the unapproved schedule is frequently a recipe for disaster.

The problem of liability for approving the schedule is minimal as long as two rules are followed. First, the owner should add cautionary language to any approval, noting that the contractor remains the party responsible for development and execution of the means, method, and timing of performance reflected in the project plan with the owner. Second, the owner should review any time frames shown on the project plan for performance of review functions, shop drawing approvals, supply of owner-furnished equipment, etc., to make certain that the owner is not being called upon to act in a manner quicker than that called for in the contract, or in unreasonably short time frames. Presumptions of correctness as to time durations for action by the owner may be inferred when the owner accepts time approval durations shorter than those called out in the specifications. *See G. Blindzius Contractors, Inc.*, ASBCA No. 37,707, 90-2 BCA ¶ 22,835 (1990).

3. APPROVAL STANDOFF

The type of project that illustrates this issue may be one, two, three, or even four years into construction—without an approved schedule for the project. The typical problem here is failure of the owner to make provision for appropriate leverage to enforce the approval process. The remedy to this problem is very simple. The owner, by a clear contract clause, should provide that no payment will be made on contract billings until a schedule is approved by the owner (absent, perhaps, some initial stipulated funding in the first month or two). If the contractor submits unreasonable or unrealistic logic, sequences, or durations (including overall project duration), the owner has the opportunity, through the power of the purse, to require that a reasonable schedule be submitted. The owner should also provide, by contract, that the contractor will be required to make all necessary schedule changes directed by the owner to arrive at a reasonable, realistic, and acceptable schedule.

4. FAILURE TO REQUIRE INITIAL AND CONTINUING INVOLVEMENT OF MAJOR TRADE CONTRACTORS

One philosophy of a certain type of general contractor is for the general contractor to provide as little information as possible to trade contractors concerning development of the original schedule, updates of the schedule, or the time status of contract completion or milestone dates, as well as the status of change orders on the project. The attitude is one of telling the trade contractor only what the general thinks is good for it. Frequently, this type of general contractor advises the trade contractor "to follow the progress of the work," and further directs the work of the various trades by weekly superintendent meetings, where weekly or monthly "lookahead" schedules are handed out. In many cases, the weekly or monthly "lookahead" schedules bear no relation to the current (or properly adjusted) contract completion dates, but may represent accelerated recovery schedules (or even in some cases undisclosed bonus schedules).

This deliberate policy of hiding information critical to trade contractors' performance is ironic when we consider the worthy and valiant efforts by general contractor organizations to sell the concept of "partnering" to the owner community. The idea in partnering is for a commitment on the part of principals to share views and resolve problems on a timely basis with structured means of resolving issues. Central to the concept is telling each other the truth. If the contractor will not have a slab poured for four weeks, then he should not lie and tell the owner it will be done in two weeks. If the owner will not have a change order issued for another month, it cannot expect to maintain credibility by saying that the modification (necessary to proceed with critical work areas) is forthcoming shortly. Successful projects must, therefore, reflect a commitment to teamwork by all the parties to the process. Although some general contractors feel they expose themselves to claims or litigation by involving trade contractors in the scheduling process, case law makes it clear that the opposite is true. Only by involving trade contractors in the scheduling and updating process can the general bind the subs to the desired logic, sequence, and durations.

5. VAGUE AND DEFECTIVE UPDATING PROCEDURES AND NECESSITY FOR JOINT UPDATES

Another area that frequently gives rise to conflict is the failure of the parties to establish monthly procedures to ensure that the historical work on the project is properly recorded and that the parties agree on the contractor's game plan for completing the work. The purpose of the updating process is threefold. First, the update should tell you where the project has been (or how you got to the point you are in the process of the job). Next, the monthly update should tell you where you are currently (as of that given point in time). Finally, the update should reflect the plan as to where you are going. Unfortunately, the recent advent of some computer software allows the contractor to override the logic of the planned diagram (without advising the owner of changes in logic, sequence, or durations). Further, it is possible to perform construction projects, using such programs as Primavera, without inserting the actual completion dates for work performed during the preceding month, and override the logic in the planned CPM without making appropriate logic changes. *See* Jon M. Wickwire & Stuart Ockman, *Use of Critical Path Method on Contract Claims – 2000* , The Construction Lawyer, Vol. 19, No. 4, October 1999.

Another problem frequently occurs on updates of construction projects. Even though the contractor may be properly updating the CPM for the project and transmitting it to the owner monthly, owner representatives (because of laziness, ignorance, or the press of other duties) may simply file the document without performing any sort of analysis as to its validity. An argument can later arise as to the actual job status as of a given update. The purpose of the joint monthly updating meeting is to force proactive and timely engagement by the parties, so that they specifically agree on the progress on the various activities during the preceding month. The record of the joint updating meeting also can be a

vehicle for contemporaneous quantification of time impacts for changes and other delays. If such delays are not priced and negotiated at the time, the historical record of the joint updating (which should include both a disk which includes associated backup and a copy of the CPM diagram with historical progress to date highlighted) will provide the necessary factual background for the parties at a propitious future date, to discuss merit and quantum.

6. PROVISION OF DEFINITIVE PROCEDURES FOR APPROVAL AND INCORPORATION OF LOGIC REVISIONS

Logic revisions concern activities, sequencing of work, or durations. In this area, the failure of owners to specify clearly approval requirements can result in major problems on projects. For example, the contractor, to avoid showing its own delay on a project, may modify otherwise valid sequential logic (of a lineup of predecessor and successor activities) to one of concurrent logic (with concurrent activities) without any notification to, or knowledge on the part of, the owner.

7. FAILURE TO PROVIDE A DEFINITE BASELINE AND METHODOLOGY FOR APPROVAL AND INCORPORATION OF TIME EXTENSIONS

One of the worst areas of conflict relating to project time relates to the failure of the specifications to spell out properly the baseline and the methodology for evaluating time requests on projects. Failure to identify clear rules for evaluating merit and quantum on time leads to a lack of clarity as well as unnecessary and unproductive gamesmanship on the part of the participants. One party states, "Let's use a contemporaneous evaluation" on one occasion. When the next issue comes up, the same party states that we should not look at the update relevant for the period, but rather should look at later updates under some theory of supervening delay. This tailoring of approaches to achieve only results favorable to one's own position results in needless disputes. A number of decisions have castigated experts and their clients for this type of attitude.

8. SUBMISSION OF THE EARLY COMPLETION NETWORK FOR APPROVAL

One of the things most capable of raising the ire of an owner is a contractor that submits a schedule for approval which provides for an early completion to the project. Courts have long held that where the owner causes a contractor's performance to extend beyond the contractor's planned completion date, the owner may be liable to the contractor for damages, even though the contract may be completed before the contractually specified completion date. The damage the contractor suffers is the loss of the benefit gained by completing the project prior to the scheduled completion. These damages are measured by defining the contractor's per diem costs in awarding the contractor delay damages equivalent to the time performance was extended beyond the early completion date. *See, e.g., Metropolitan Paving Co. v. United States*, 163 Ct. Cl. 420, 325 F.2d 241 (1963); *Maurice L. Bein, Inc. v. Housing Authority,* 157 Cal. App. 2d 670, 321 P.2d 753 (1958).

There are a few potential answers to this problem. First, the owner may simply decide to discourage early completion efforts by calling out in the specifications that any submission, coupled with subsequent approval, of a contractor schedule showing an early completion will have the effect of moving the contract completion date to the earlier date, which will be the new point for the assessment of liquidated or actual damages. Another approach is simply to refuse to approve a schedule calling for early completion, so long as the owner can establish that the submitted schedule does not reflect a reasonable plan for performance. *See, e.g., Sierra Blanca, Inc.*, ASBCA Nos. 32161 *et al.*, 90-2 BCA ¶ 22,846 (1990). Finally, the owner who receives an early completion schedule about which it is concerned, but which it is not prepared to state is clearly wrong, may wish to consider the following course. First, indicate doubts about the reasonability of the proposed early date. Second, indicate that the

owner will have to change its economic position to accommodate the early date (assuming this is correct). Third, advise that the owner will suffer damages if the early date is not met, because of the change in position. Finally, note that if the contractor wishes the owner to approve the early date, written confirmation must be provided acknowledging the contractor's liability for any damages incurred by the owner's change in position in the event the early date is not met (or adjusted for any time extensions). Importantly, courts have recently found that approvals of early completion schedules will be thrown out if the underlying schedule is based on unrealistic logic and durations. *See Neal & Co. v. United States*, 36 Fed. Cl. 600 (1996), *aff'd* 121 F.3d 683 (Fed. Cir. 1997).

II. CPM PROOF OF DELAY CLAIMS

Network analysis techniques were introduced into the construction field in the early 1960s. Since that time, government specification of the use of network analysis techniques for major projects is now commonplace. There is also now a perception by contractors (after a period of initial resistance) that network analysis techniques can be extremely important tools for project management. Accordingly, the use of CPM to plan and schedule work has become the accepted standard in the construction industry. Further, boards of contract appeals and the courts have shown their willingness to utilize network analysis techniques to identify delays and disruptions on projects, as well as the causes of delays and disruptions.

A. THE "CLASSIC TECHNIQUE" WHICH UNDERLIES CPM ANALYSIS OF TIME RELATED CLAIMS

The basic technique used in evaluating contract claims with CPM is to compare the as-planned CPM schedule with the as-built CPM schedule. The technique can be summarized in the following six questions:

1. How was it planned that the project would be constructed?

2. Was the plan reasonable?

3. How did construction actually occur?

4. What are the variances, or differences, between the plan for performance and the actual performance with respect to activities, sequences, durations, manpower, and other resources?

5. What are the causes of the differences or variances between the reasonable plan and the actual performance?

6. What are the effects of the variances in sequence, duration, manpower, and so on as they relate to the costs experienced, both by the contractor and the owner for the project?

B. METHODS FOR PROOF OF DELAY CLAIMS—AN OVERVIEW

As noted, scheduling has become a means of both guiding performance through the contract's life and gauging the accuracy and appropriateness of performance claims. In that regard, there are a variety of potential choices for the use of schedules to analyze project delays. A listing of these choices, along with a summary of advantages and disadvantages, is noted below:

1. BAR CHART

Bar chart techniques are more than 90 years old and they continue to play a role on projects where we have a few activities with linear-type relationships between those activities. This type analysis is of limited help (without extensive supporting testimony) in proving the impact of construction delays on modern, complex construction projects with a variety of activities, complex logic relationships (predecessor, successor, concurrent), and with varying resource requirements and availability. For example, in a 1998 decision, the Court of Appeals for the Federal Circuit affirmed a board decision which had criticized "the bar chart appellant provided which lacked a critical path, a favorite device with present day fact finders in contract disputes." *Al Johnson Construction Co. v. United States,* 854 F.2d 467, 470 (Fed. Cir. 1988).

Bar charts, however, have been permitted to prove delay in circumstances in which a CPM was not used to execute the work, costs of CPM analysis are prohibitive, and manifest delays of the owner are present. For example, in *Lamb Eng. & Constr. Co.*, EBCA No. C-9304172, 97-2 BCA ¶29,207, the board noted that although the contractor would have benefited by using CPM analysis, it found that the complexity of the Project did not necessitate such analysis. Because this was coupled with serious, manifest government misconduct, the Board allowed the contractor recovery on its delay claim. See, also, *Hoffman Constr. Co. v. U.S.*, 40 Fed. Cl. 184 (1998).

2. "BUT FOR" ANALYSIS / COLLAPSED AS-BUILT

This analysis calls for a protocol where we (1) compare the reasonable planned schedule to the as-built schedule with all delays encountered on the project; (2) remove the delays of the other party from the as-built schedule; (3) review the collapsed as-built for anomalies representing "why hurry up and wait" type of activities (rescheduled due to prior delays), and make appropriate adjustments to remove the anomalies to arrive at an adjusted "but for" CPM analysis of project delays.

Perceived advantages of this approach are that it is based on the actual events on the project; it allows us to compare a reasonable plan for performance with the as-built schedule. We can then identify variances between the plan and actual, look for causes of the variances, and finally determine what, if any, the effects of the variances may be. We can also compare our "But For" collapsed as-built with the plan and actual to get an idea, not only of delay effects to the critical path, but also to make judgments relative to issues of lost efficiency.

There are a number of disadvantages of the collapsed as-built CPM. First, the after-the-fact approach fails to address the need to address the issue of time extensions on a real time basis as required to address events on the project. Second, the analysis is not forward looking, chronological and cumulative. Third, in order to collapse the schedule, the analyst is typically forced to insert after-the-fact logic ties which may not reflect the thinking of the executor of the schedule during actual performance. Fourth, adjustments for anomalies in the adjusted schedule require experienced judgment, beyond the capability of many analysts, and may be subject to dispute by experienced experts for others on the project. Regardless of these disadvantages, "But For" analyses have, in the past, been accepted as valid. *Fischbach & Moore Int'l Corp.*, ASBCA No. 18,146, 77-1 BCA ¶ 12,300 (1976); *John Murphy Constr. Co.*, AGBCA No. 418, 79-1 BCA ¶ 13,836 (1979).

3. "TOTAL TIME" ANALYSIS

Total cost pricing, which asks the other party to pay for all losses on a project (actual costs plus mark-ups less contract price), is subject to serious objections due to underlying assumptions. For example, the approach assumes that the contractor's original bid was reasonable, that the contractor

performed as efficiently on the project as anticipated in its bid, and that all the causes of the increased costs on the project were the sole responsibility of the owner.

Likewise, a "Total Time" Analysis which compares the contractor's plan with the actual as-built schedule, and blames the owner for all the variances, is subject to similar attack for the underlying assumptions. These include the assumption that the original plan was reasonable, that the contractor performed at least as efficiently as planned, and that all the variances between the planned and actual are the responsibility of the owner (not due to excusable or contractor delays). There are a number of court and board decisions which have rejected the "total time" type analysis.

For example, in *Morganti National, Inc. v. United States,* the court noted that the Contractor's expert "simply takes the original and extended completion dates, computes therefrom the intervening time or overrun, points to a host of individual delay incidents for which defendant was allegedly responsible and which 'contributed' to the overall extended time, and then leaps to the conclusion that the entire overrun time was attributable to defendant." The court held that a "total time" approach to proving delay was "as unsatisfactory as the 'total cost' method of proving damages," and denied the contractor's claim. 49 Fed. Cl. 110 (2001), aff'd. 36 Fed. Appx. 452 (2002). Similarly, the board in *Southwest Marine, Inc.*, rejected the contractor's "disfavored total delay" theory, noting "cumulative inefficiency or impact is not proved by the issuance of numerous change orders without proof that these change orders proximately caused that indirect or cumulative inefficiency or impact." ASBCA No. 36854, 95-1 BCA ¶27,601 (1995). *See also Santa Fe Engineers, Inc.,* ASBCA No. 24,578, et al., 94-2 BCA ¶26,872 (1994). (Board rejected total time approach because it believed some of the delays present might have been the contractor's responsibility.)

4. "IMPACTED AS-PLANNED" CPM

This approach, which purports to present a fair picture of responsibility for owner delays on the project by impacting the original CPM on the project solely with owner delays encountered during performance, suffers from one fatal flaw. It ignores what actually happened on the project. This approach totally ignores excusable delays and delays by the contractor. Actual performance by all parties must be considered. Thus, hypothetical impacted as-planned network delay analyses that do not take into account actual events on the project as they evolve have been held unacceptable measures for evaluating project delays. *Gulf Contracting, Inc.*, ASBCA Nos. 30195, et al., 89-2 BCA ¶ 21,812 (1989), *aff'd Gulf Contracting Co. v. U.S.*, 23 Cl. Ct. 525 91991), *aff'd* 972 F.2d 1353 (Fed. Cir.), *cert. den.*, 113 S.Ct. 598 (1996); *Titan Pacific Constr. Corp. v. U.S.*, 17 Cl. Ct. 630 (1989).

5. CHRONOLOGICAL AND CUMULATIVE APPROACH / TIME IMPACT ANALYSIS

This approach was developed to address the needs of the construction process to recognize time adjustments due the contractor in a timely manner and to provide the ability to resolve disputes prior to some exhaustive after-the-fact analysis reconstructed after the completion of the project.

In this approach, we start with a reasonable as-planned CPM; next, we status the project (to take into account past performance) prior to the onset of a delay which we wish to evaluate; in statusing the project we identify the location of the critical path. The original as-planned schedule is then modified from that point forward, incorporating the time impact which may or may not cause a project extension based on the location of the critical path and its relation to the delay in question. When the next delay is evaluated, the project network (as revised by the prior analysis and taking into account actual events on the project) is again statused immediately prior to the advent of the delay to locate the critical path; the second delay is then introduced into the network to see what result it may have.

This approach has been widely accepted and has significant merit. *See, e.g.*, SAE/Americon-Mid Atlantic, Inc., GSBCA Nos. 12,294, et al., 98-2 BCA ¶30,084 (1998). However, care must be taken to make sure that during the period of the analysis of individual delays, other delays which may be the responsibility of the contractor or owner do not overtake the delay in question on the critical path. One way to avoid this problem is through the use of measuring points such as monthly updates. In this manner, the fact finder cannot only look at the location of the critical path at the inception of the delay, but also confirm the actual impact of delay by looking at the project status at the end of the update and the history of actual events of the project in between. This allows the fact finder to identify and net out concurrent delays from consideration of compensability.

6. "WINDOW ANALYSIS"

This type of analysis is a variant of the chronological and cumulative approach detailed above. In this approach, we look at the status of the project immediately prior to the advent of the delay, such as the monthly update of the CPM for September. We then introduce the actual events and delays into a window of time, typically an update as they occurred. We would then see which delays impacted the critical path, as well as which delays may have represented concurrent delays to the critical path. Like the chronological and cumulative approaches, this is a valuable tool and has been accepted by boards and courts.

Cogefar-Impresit U.S.A., Inc., is a case that provides some lessons on the treatment of time impact and window analyses. In that case, the contractor was required to submit time impact analyses to establish entitlement to time extensions. The board found that the owner waived the right to terminate for default for delays, including the failure to submit time impact analyses in their proper form. Further, the board determined that the owner presented incorrect "window" analyses of delays because the "window analyses" failed to reflect actual conditions on the project at the time of the delays. This ruling was based on the principle that any evaluation of project delays must be based on a CPM schedule that is "current" as of the delays. DOTBCA No. 2721, 97-2 BCA ¶29,188 (1997).

C. THE CPM EXPERT AND THE NEED FOR IMPARTIALITY

Although the use of network analysis techniques to prove delay claims is now commonplace, a number of industry challenges remain. As the courts and boards of contract appeals become more knowledgeable about network analysis techniques, they have also become more skeptical about expert scheduling testimony which appears biased and result driven. It is clear, therefore, for expert scheduling testimony to be of value, it must reflect a fair and complete review of the project data and must reflect analyses that take into account major and controlling delays of all parties on the project.

The challenges facing the industry have been increased by the significant developments that have occurred in the federal arena during the past decade concerning the use and admissibility of expert testimony. These developments have effectively given the courts the power to exclude, prior to trial, "junk science" as well as other testimony that is "unreliable" for a number of reasons. *See Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993) (interpreting Rule 702 of the Federal Rules of Evidence). Under *Daubert* and subsequent cases, there is a clear potential to completely exclude expert testimony that may be essential to prove a cause of action for delay recovery or to deny such recovery, unless a proper groundwork has been laid by the party seeking to introduce such testimony.

Rule 702 of the Federal Rules of Evidence adopted in 1975 and amended in 2000 states:

> If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine fact in issue, a witness qualified as an expert by

> knowledge, skill experience, training, education may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case.

Under the Federal Rules of Evidence, the trial court must determine whether the proffered expert is reliable and fits the facts of the case. In *Daubert*, the Supreme Court provided guidance on the application of these principles. In that context, "scientific knowledge" requires that the proposed expert opinion be grounded in the methods and procedures of science. Further, knowledge means more than subjective belief or unsupported speculation. "Scientific knowledge" means "any body of known facts or . . . any body of ideas inferred from such facts or accepted as truths on good grounds." Further, the court in *Daubert* found that the trial court had the duty to act as a "gatekeeper" to determine the qualifications of the proposed expert scientific testimony *before* the trial court admits the testimony. In addition, in *Daubert*, the Court found that the gatekeeper function applied not just to novel testimony but also to more established scientific testimony. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. at 590-593 (1993). Further the 2000 amendments to Rule 702 incorporated the requirement that the trial court assure the reliability of even conventional expert testimony before admitting it into evidence. The federal principles set forth in *Daubert* are also used as guidance, if not precedent, by state courts, board of contract appeals and arbitration panels.

For example, in *The Sherman R. Smoot Corp.*, ASBCA No. 52261, 03-1 BCA ¶ 32,197 (2003), the contractor moved to exclude the testimony and written report of the government's proposed expert witness who had prepared a CPM schedule analysis in an attempt to refute the contractor's delay claim. The contractor contended that the government's proposed witness was not qualified as an expert in construction CPM schedule analysis and could not assist the trier of fact to understand the evidence or to determine a fact in issue, pursuant to Rule 702 of the Federal Rules of Evidence. In ruling on the contractor's motion, the presiding judge at the board hearing reviewed the expert's qualifications set forth in his curriculum vitae, deposition transcript and proposed expert report. The expert's curriculum vitae indicated that he had a Bachelor's and Master's Degree in Chemical Engineering and a Ph.D. in Industrial Engineering and industrial experience at Phillip Morris USA. The expert had also testified in his deposition that he lacked education and experience in construction, and his study and teaching of PERT/CPM analysis were in manufacturing and production, not construction. The expert further admitted in his deposition transcript that he had not prepared a construction schedule, had not used the terms "excusable" and "compensable" delay in dealings with contractors, and he was not an expert in "concurrency." After hearing this evidence, the presiding judge at the board hearing granted the contractor's motion to exclude from evidence the testimony and written report of the government's proposed expert. In so ruling, the presiding judge noted that the expert's qualifications in construction CPM generation, adjustment and analysis were "quite thin" if not nonexistent. In the subsequent written decision on the contractor's claim, a three-member panel of the Armed Services Board of Contract Appeals affirmed the exclusion of the expert testimony and report. 03-1 BCA ¶ 32,197 at p. 159,151. *See also The Sherman R. Smoot Corp.*, ASBCA Nos. 52,173, et al., 03-1 BCA ¶ 32,212.

Of course, even when expert scheduling testimony has passed the *Daubert* test and is actually admitted in a court or board proceeding, if such testimony is not based on a fair or impartial review of the project record, it will most likely be found unpersuasive. Several recent board and U.S. Court of Federal Claims cases are illustrative.

In *Fraya, S.E.,* ASBCA No. 5222, 02-2 BCA ¶ 31,975 (2002), the government terminated a contractor for failure to make adequate progress on a renovation project in Puerto Rico. The contractor challenged the termination for default and offered the expert CPM testimony attempting to demonstrate that the contractor could, in fact, have completed the contract on time. The Board rejected the expert's

analysis and denied the contractor's appeal. Instead of using industry recognized estimating guides, the expert had used what he referred to as "ways and means" of construction. This "ways and means" method of estimating later turned out to be nothing more than the contractor's oral estimates of the time required for various tasks. The Board also rejected the expert's planned schedule because it was not resource loaded as required by the contract, did not take into account the limited building access because of security requirements, and failed to take into account the fact that the construction industry in Puerto Rico took extended holidays in December and January.

The contractor's CPM expert analysis was also rejected in *Jimenez, Inc.*, VABCA No. 6351, et al., 02-2 BCA ¶ 32019 (2002). In this case, the contractor argued that delays resulting from the government's tardy approval of an air handling unit were compensable. The installation of the air handling units, however, were never shown as a critical path activity on any of the contractor's schedules that it had submitted during the performance of the project. Faced with that fact, the contractor hired a CPM expert. As the Board noted, "not surprisingly," this expert's newly created CPM analysis showed that the delays to the air handling units accounted for the entire project delay. The Board rejected the expert's opinion and noted that "such self-serving analyses, created after project completion which make adjustments to attain new and revised projected schedules, depending on theoretical contingencies, are of limited value." 02-2 BCA ¶ 32,019 at p. 158,252.

A CPM's expert's failure to apportion government delays from concurrent contractor delays resulted in the complete rejection of a contractor's delay claim in *Manuel Bros., Inc. v. United States*, 55 Fed. Cl. 8 (2002). In this case, the contractor entered into an agreement with the Federal Aviation Administration to excavate and install concrete duct banks and manholes necessary for the installation of new fiber optic lines at the Dallas-Ft. Worth International Airport. The contractor sought over $2 Million in delay-related damages based upon its allegation that the critical path of the project had been directly affected by (1) differing site conditions involving clay and rock; (2) breach of the government's implied duty to cooperate which limited the contractor's access to the project site; and (3) additional time required for the location of unknown or misplaced utilities. Of the contractor's three claims, the court held that only the third, concerning the unknown misplaced utilities, was meritorious. The contractor's CPM expert testified that the contractor had been delayed for a total of 7½ months as a result of the three problems. The expert, however, could not give an opinion on the precise number of days of delay attributable to each issue. He also admitted he had based most of his analysis solely on information provided by the contractor's employees. Because the contractor could not separate the government caused delay from the contractor's own delays, no delay damages were awarded.

D. CONCLUSION

The use of inexperienced personnel to schedule work and so-called "user friendly" software advances that mask the logic and changes to CPM networks have also lead to serious scheduling abuses. A significant development in the fight to establish ethical and professional scheduling practice is the formation of the College of Scheduling within PMI, the Project Management Institute. The primary purposes of the College include facilitating training of professional schedulers, fostering best practice standards in the scheduling field, eliminating software user abuses, and establishing standards for ethical conduct. With this and other industry initiatives, the future of CPM scheduling in the construction field remains bright.